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DESIGNING AND IMPLEMENTATION OF A HARDWARE MODEL OF POWER RATIONING USING LAB VIEW INSTRUMENTATION SYSTEM

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ABSTRACT

This paper focuses the designing idea of Power Rationing using the LabView Instrumentation System and the implementation and testing of prototype model using the LabView instrumentation system. Power shortage is a fact of everyday life in many parts of the world... The impact of an electricity shortfall on an economy can be high. Analysis of electricity shortfalls underscores the importance of a comprehensive crisis management approach, including measures to address both supply and demand. Supply side measures include reducing energy production losses and removing transmission bottlenecks.

KEYWORDS: Power Rationing, Energy Demand & Energy Management System

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Original Article

INTRODUCTION

Electricity shortfalls or power shortage can be caused by many factors, including insufficient and/or compromised energy inputs, generation, transmission or distribution. Understanding the cause of an electricity shortfall is vital in determining which energy-saving measures to promote, as the effectiveness of each measure can vary depending on the nature of an electricity shortfall. A country facing a capacity shortage (e.g., electricity shortfalls during peak hours) should focus on measures that decrease electricity consumption during those key times. Many industries, for example, are shifting operations to evenings and weekends when electricity demand is lower [1-5]. Such load shifting helps to reduce demand during peak-power periods but does not decrease overall electricity consumption.

Power shortages seldom have a single cause. However, a typical pattern begins with underinvestment or very rapid growth that degrades reserve margins below accepted reliability levels, with an acute crisis, then brought on by unusual conditions of weather, fuel supply, plant availability or all three.

The electricity industry is changing rapidly. The last decade has seen the rapid growth of distributed generation (mostly in the form of wind farms), demand peaks that are intensifying and increased pressure from stakeholders and regulators for asset efficiency. The result is that the electricity industry is one of the few sectors where unconstrained consumption is starting to be actively discouraged.

This paper explores a designingmodel of a simple power rationing scheme based on energy quotas assigned to individual consumers and a real-time display showing consumption of the previous period, highlighting peaks

and troughs in consumption. Consumption rationing has proven flexible and resilient in many electricity shortfall situations and the rationing allows officials to influence electricity consumption in a very direct way, by controlling the amount or timing of energy supply or obliging consumers to control their consumption subject to penalties.

METHODOLOGY

Block Diagram

Demand response depends on shifting energy demand periods. This can be done manually, but this reduces its effectiveness as end users may be unavailable to respond or disinclined to do so. The linkage between the energy meter and home appliances could allow the appliances to be controlled via the meter communication link according to the energy supply contract with the end user [6-10].

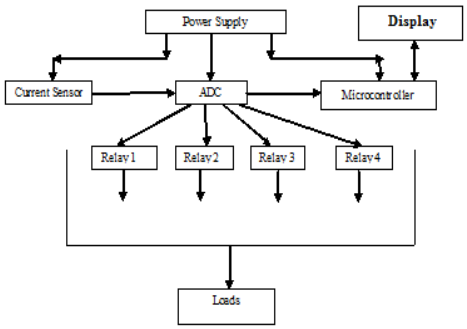

Figure 1: System Block Diagram

Other energy saving measures, such as turning off lights or standby appliances according to a timed program could also be offered. The future home energy management may include dynamic models and optimization of energy use taking into account occupancy, environmental conditions, time variable energy price and preferences of the inhabitants. The block diagram of under consideration is shown in Figure 1. It consists of current sensor, analog to digital converter, Atmel microcontroller and relays. Here current transformer used as a current sensor.

CIRCUIT ARRANGEMENTS

This proposed model Control/Display unit contains the Energy/Sentry microcontroller based computer which automatically controls loads connected through the relays in the relay unit. Commands to switch the loads originate and the loads are based on the demand limit and the actual demand as measured by the current transformers. . Current transformer detects electrical current in the circuit and it generates a proportional voltage signal [11]. The different units measure instantaneous power and automatically calculate the power used that is exceeding the contracted power. Therefore, any load can be quickly and reliably disconnected with relays. The proposed method is the most common and intelligent method. It makes a forecast of the situation at the end of the period and optimizes loads, so that the maximum number of loads can be connected, ensuring that the maximum limit programmed is not exceeded. The voltage signal could be analog voltage; it can be utilized for control purpose. The analog signal is converted into a digital signal by using analog to digital converter. The converted signal is then given as digital input to the microcontroller. The microcontroller compares the consumed current with the reference current. If the consumed current exceeds the reference currency, the forthcoming load cannot be operated. Therefore the maximum demand can be prevented and power rationing is achieved.

A microcontroller is used to monitor the demand. The maximum demand was programmed into the microcontroller. The load current Iref was sensed by the current transformer, then converted into a voltage proportional to the load current. The voltage is given as an input to the analog to digital converter; the digital output from an analog to digital converter is given as input to the microcontroller.

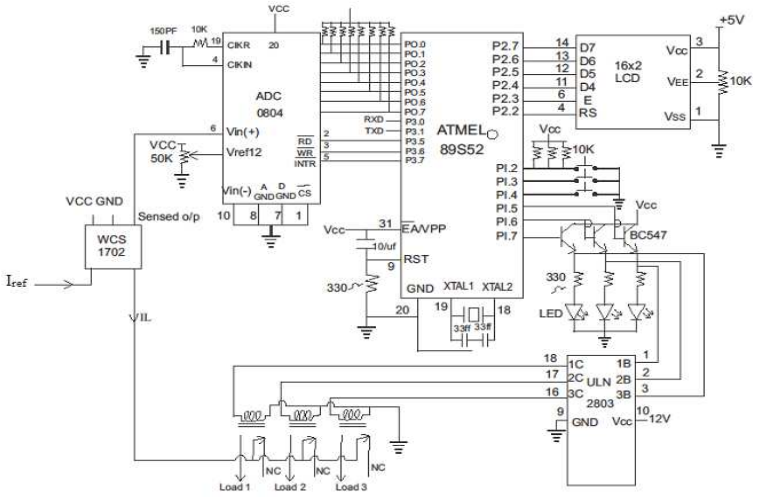

Figure 2: Circuit Arrangement

The microcontroller gives signal to the relay driver circuit ULN 2803 after comparing the current demand with the maximum demand. The relay driver circuit strengthens the weak signal from microcontroller to the range it can drive the relay. The proposed circuit arrangements shown in Figure 2. The LabView instrumentation system enables a convenient remote display of variables such as number of units consumed, unit cost, total cost, momentary demand, cumulative demand and time remaining within the current measuring interval.

LABVIEW MODEL

Lab View is a graphical programming language that uses icons instead of lines of text to create applications. LabView applications often are called virtual instruments, or VIs, because their appearance and operation often imitate physical instruments, such as oscilloscopes and multimeters. The proposed LabView model is shown in Figure 3. Virtual instrumentation is applicable in many different types of applications, starting from design to prototyping and deployment.

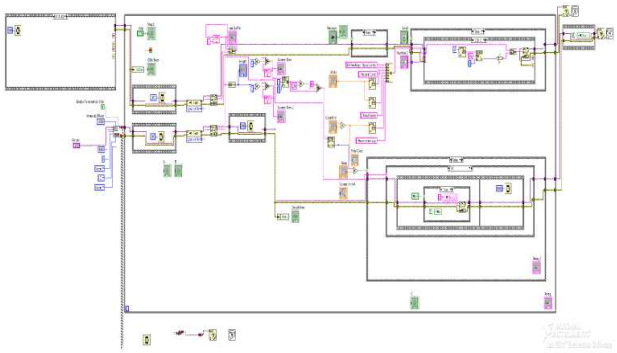

Figure 3: Lab View Model

Virtual instrumentation is applicable in many different types of applications, starting from design to prototyping and deployment [12-13]. The LabView platform provides specific tools and models to solve specific applications ranging from designing signal processing algorithms to making voltage measurements and can target any number of platforms from the desktop to embedded devices with an intuitive, powerful graphical paradigm. A virtual instrument consists of an industry-standard computer or workstation equipped with powerful application software, cost-effective hardware such as plug-in boards, and driver software, which together perform the functions of traditional instruments [14-19].

HARDWARE MODEL

The main objective of the proposed hardware model is to provide power rationing scheme based on energy quotas assigned to individual customers. For this prototype model maximum load current is taken from a reference (Iref = 80mA) current. If the total load current exceeds the reference current, automatically further load cannot be operated.

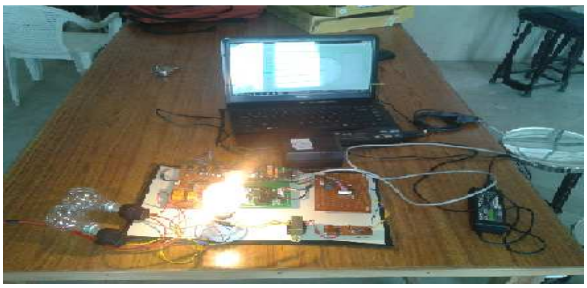

Figure 4a: Hardware Model

When the consumer reaches the maximum demand the controller will not allow the consumer to access succeeding load. For experimental purpose here we are connecting 3 numbers of 40 watt bulbs as a load and maximum demand is 140watts. Therefore the reference current Iref = 60mA. Figure 4a and 4b shows a prototype hardware setup of the proposed model.

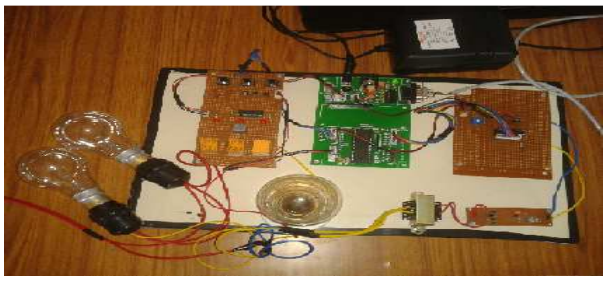

Figure 4b: Hardware Model with Load

The controller compares this running average with a set target load value and operates a set of relays if the target appears in maximum of being exceeded. The relay contacts are used to switch off further electrical loads and hence hold the overall load to a prescribed limit. A visual display is provided of the running average, which can also display the target value or the recorded maximum.

OUTPUT AND RESULTS

The LabView Instrumentation system together with the power rationing model described above is tested in a Laboratory. It provides Initial screen, Load ON/OFF condition, unit consumed, unit cost, total cost and monitors the entire above shown in Figure. 5.

Figure 5: Lab View Control Panel Screen

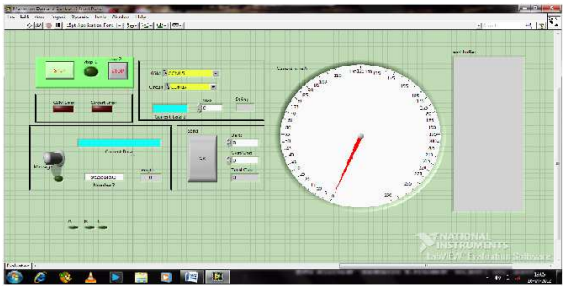

Figure 6: Lab View Control Panel Screen

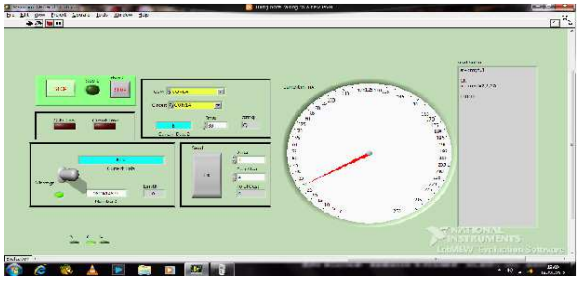

Figure 7: Lab View Control Panel Screen

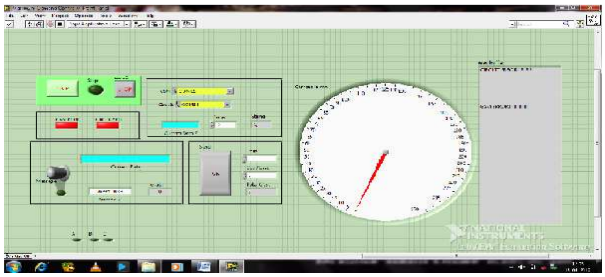

Figure 8: Lab View Control Panel Screen

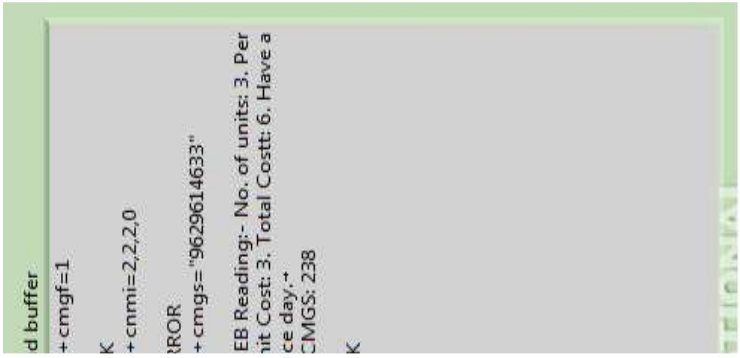

Figure 9: Lab View Control Panel Screen

Figure Lab View Control Panel Views

Figure 5: Front Panel Screens of Lab View Model with Different Load Conditions and Display Unit

Although the PC and integrated circuit technology have experienced significant advances in the last two decades, the software truly offers the flexibility to build on this powerful hardware foundation to create virtual instruments, providing better ways to innovate and significantly reduce cost.

CONCLUSIONS

The experimental model for Power Rationing using the LabView Instrumentation system was implemented and tested. Thus, a more reliable and economical operation is achieved. This provides simple power rationing scheme based on energy quotas assigned to individual consumers. The proposed method is based on precision electronic circuits and based on the LabView program, for processing, displaying and storing the data. The proposed model has the advantages of rapid development and flexibility in the case of changes, while it can be easily extended for future development.

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